

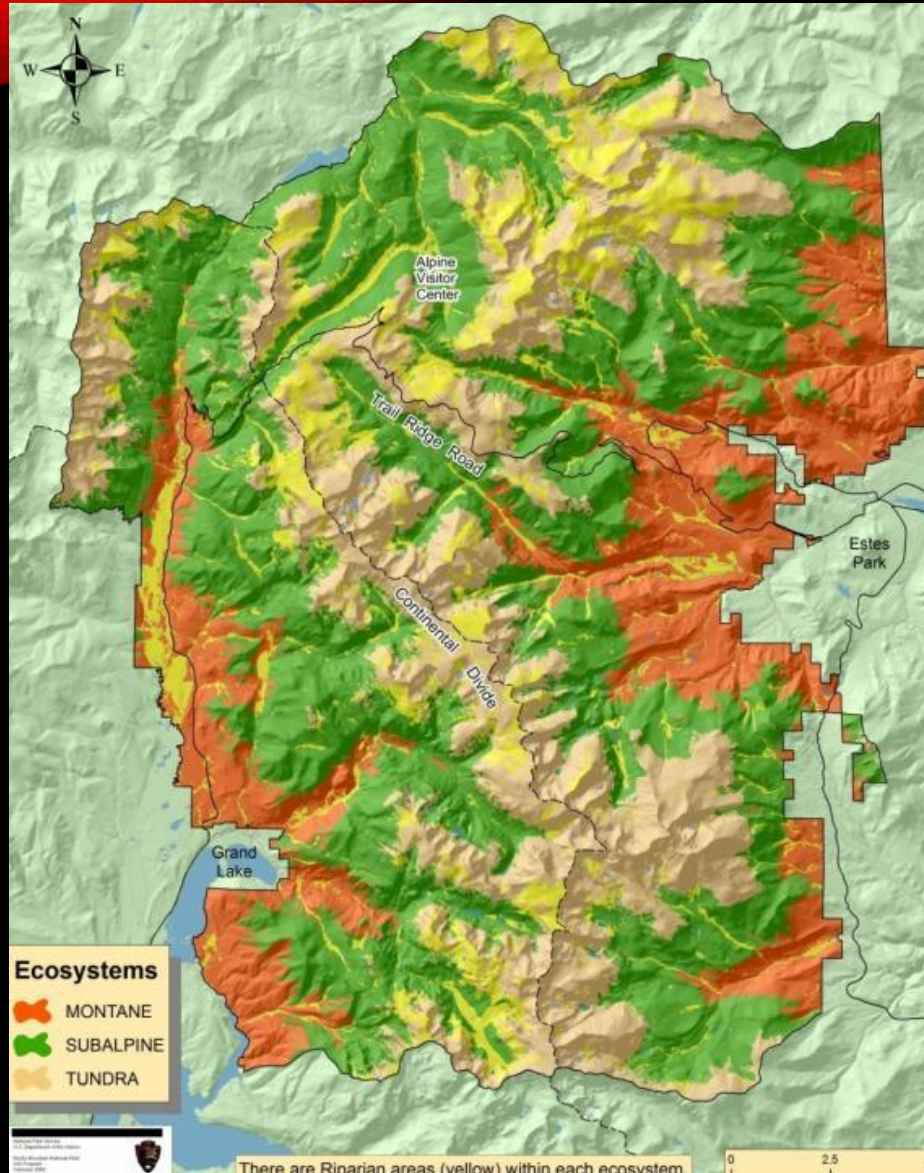


THE ROCKY MOUNTAIN NATIONAL PARK AIR QUALITY INITIATIVE: AIR QUALITY CONTROL COMMISSION ANNUAL BRIEFING

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RMNP AQ INITIATIVE: BACKGROUND



- Interagency effort addresses air pollution issues in RMNP
 - Focus on nitrogen deposition
- “Weight of the evidence” approach considers:
 - Monitoring/trends
 - Attribution studies
 - Planned reductions
- Nitrogen Deposition Reduction Plan (2007)
- Contingency Plan (2010)
- 2012 Milestone Report (2014)

Alpine more susceptible to effects from Nitrogen deposition

precipitation + high NO_x + high NH_x = higher deposition rates

thin soils

low rates of plant growth

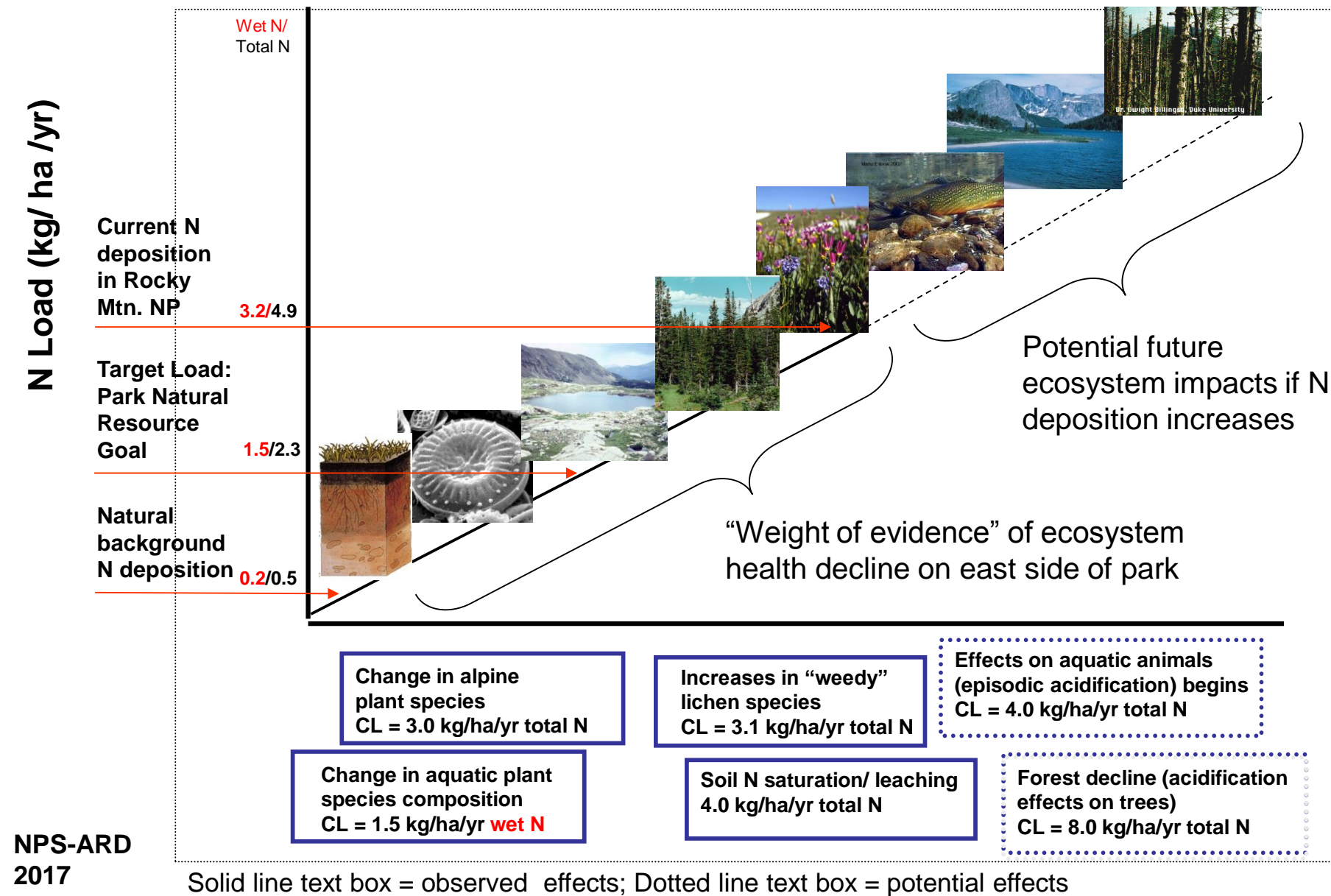
vegetation & soils have limited capacity to buffer
the chemical effects of N deposition

CRITICAL LOAD

- Large body of evidence indicates nitrogen deposition has affected and continues to cause harmful effects on sensitive ecosystems within the park.
- Current wet deposition monitored at ~3.2 kg N/hectare/year (rolling 5-year average - 2011-2015)
- Natural background estimated at 0.2 kg N/hectare/year
- Specific, published (peer-reviewed) research has shown that wet deposition levels at the time harmful effects started to occur was ~1.5 kg N/ha/yr.



Rocky Mountain National Park: Continuum of Impacts to Ecological Health

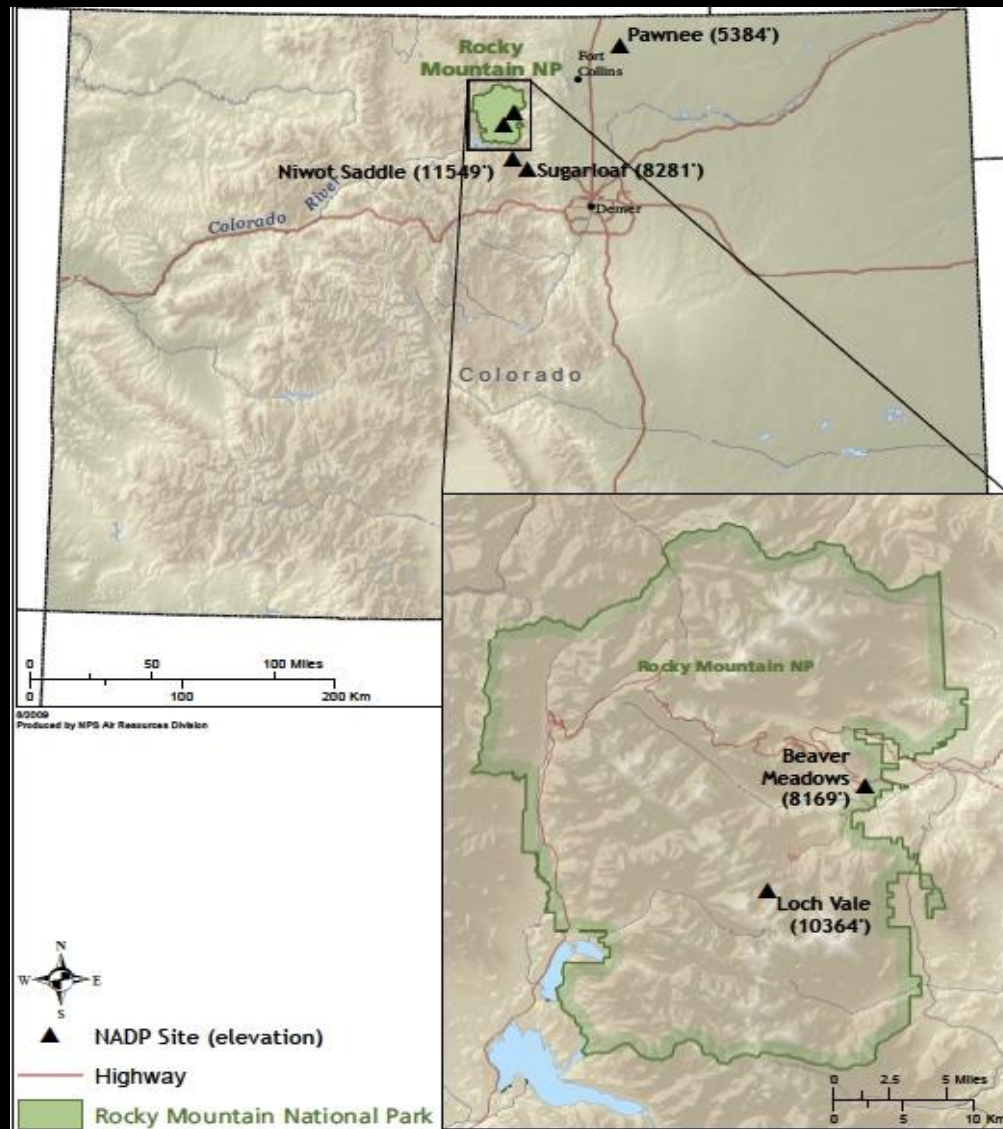


NITROGEN DEPOSITION REDUCTION PLAN & CONTINGENCY PLAN

- Original NDRP endorsed by NPS, EPA and CDPHE and the Colorado Air Quality Control Commission on August 16, 2007
 - 1) Management approach based on collaborative process
 - 2) Voluntary approach, no mandatory requirements or standards
 - 3) Sets long-term (25-year) resource management goal
 - 4) Sets timeline and interim (5-year) milestone goals intervals to achieve nitrogen reduction goal by 2032
 - 5) Strategies to achieve goal
 - 6) Identifies options that can be implemented on a voluntary basis
- Contingency Plan endorsed by NPS, EPA and CDPHE and the Colorado Air Quality Control Commission on June 22, 2010
 - ❖ Adaptive management approach consisting of 5 elements
 - 1) Data Tracking Plan
 - 2) Triggering Mechanism
 - 3) Recommending & Implementing Contingency Measures
 - 4) List of Potential Contingency Measures
 - 5) Public Outreach & Participation



DEPOSITION TRENDS THROUGH 2015



MONITORING & TRACKING

- Wet nitrogen deposition has stabilized in both the long- and short-term
- Long-Term Statistical Trend (1984-2015*):
 - Wet nitrogen deposition increased at RMNP Loch Vale until 2010 and is now stable, although it continues to increase at RMNP Beaver Meadows
 - Ammonium is increasing at all 5 sites
 - Nitrate is decreasing at 2 sites
- Short-Term 5 or 7 year Statistical Trends (2011-2015 or 2009-2015):
 - Wet nitrogen deposition is stable at all sites
 - Ammonium is increasing at 3 sites
 - Nitrate is decreasing at 1 sites
- Loch Vale Co-located site (2009 - 2013)
 - Provided QA/QC support for trends
 - Basis for confidence intervals

*Site records vary between 1980 and 1987



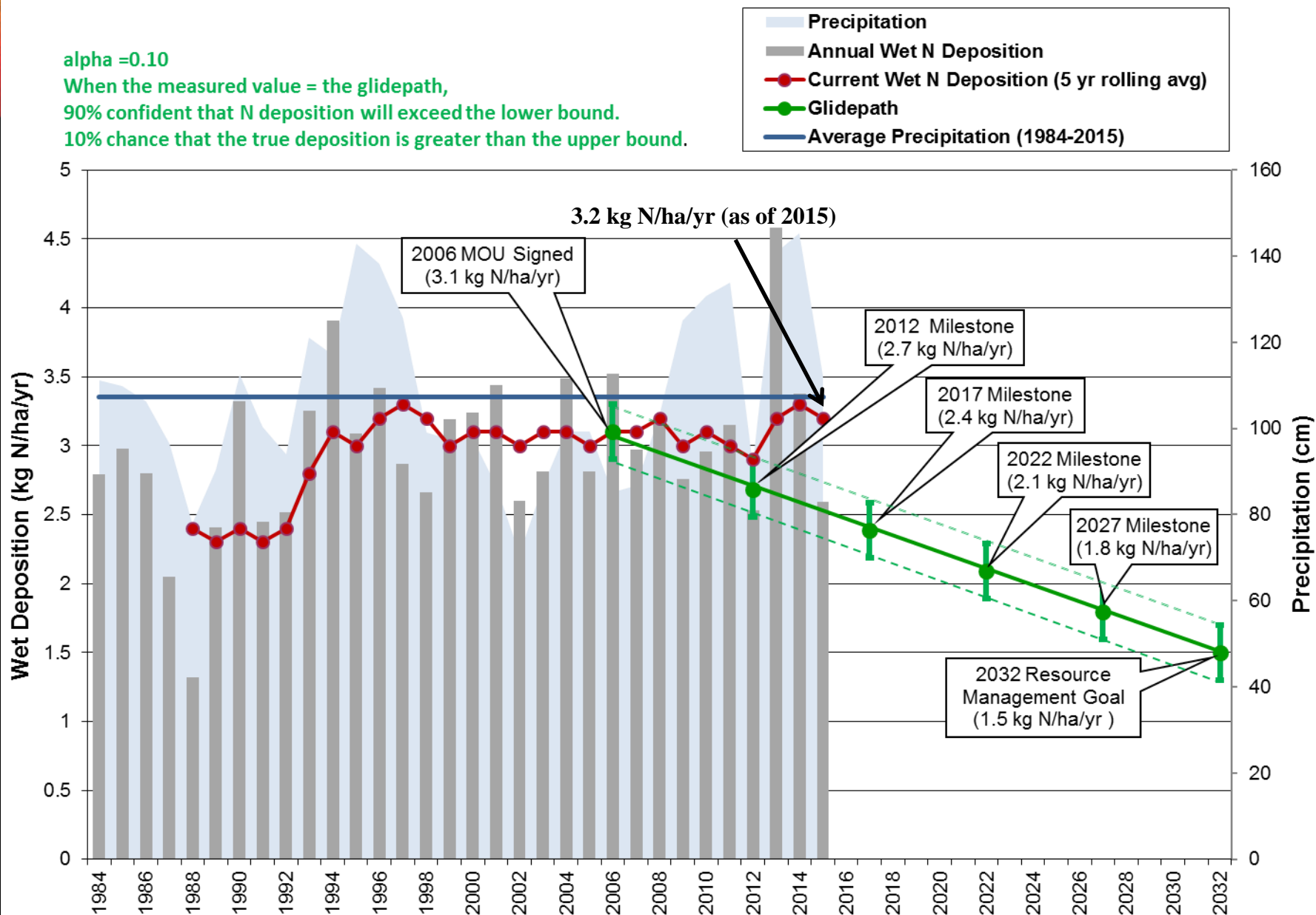
RMNP LOCH VALE NITROGEN DEPOSITION & NDRP GLIDEPATH

$\alpha = 0.10$

When the measured value = the glidepath,

90% confident that N deposition will exceed the lower bound.

10% chance that the true deposition is greater than the upper bound.



NITROGEN SOURCE AREAS & TRANSPORT PATTERNS

- During spring and fall upslope weather events, high concentrations of both types of nitrogen move from eastern urban & agricultural areas of Front Range to RMNP
- Regular summer upslope transport from mountain valley convection
- Substantial portion of deposited nitrogen originates in Colorado
 - More than 40% of ammonia from CO, about 70% from Front Range (Denver to state line), Morgan, and Weld counties
 - Less than 50% nitrogen oxides (NO_x) from Colorado
 - Reducing NH_x emissions in closer proximity to park have greater positive effect (not all emissions are equal)
- In-park/nearby sources of ammonia not considered significant contributors to deposition in RMNP



Agricultural Best Management Practices:

Helping to Reduce Nitrogen Impacts at Rocky Mountain National Park



Rocky Mountain NP, Colorado



**Colorado
Dairy
Farmers**



AGENCY EFFORTS WITH COLORADO AGRICULTURE

- What does success look like with CO Agriculture?
 - reduced nitrogen deposition contributions
 - ongoing collaboration
 - filling data gaps
 - demonstrated implementation of BMPs
 - Increasing participating producers
 - Early Warning System implementation



COLORADO AGRICULTURE DISCUSSIONS

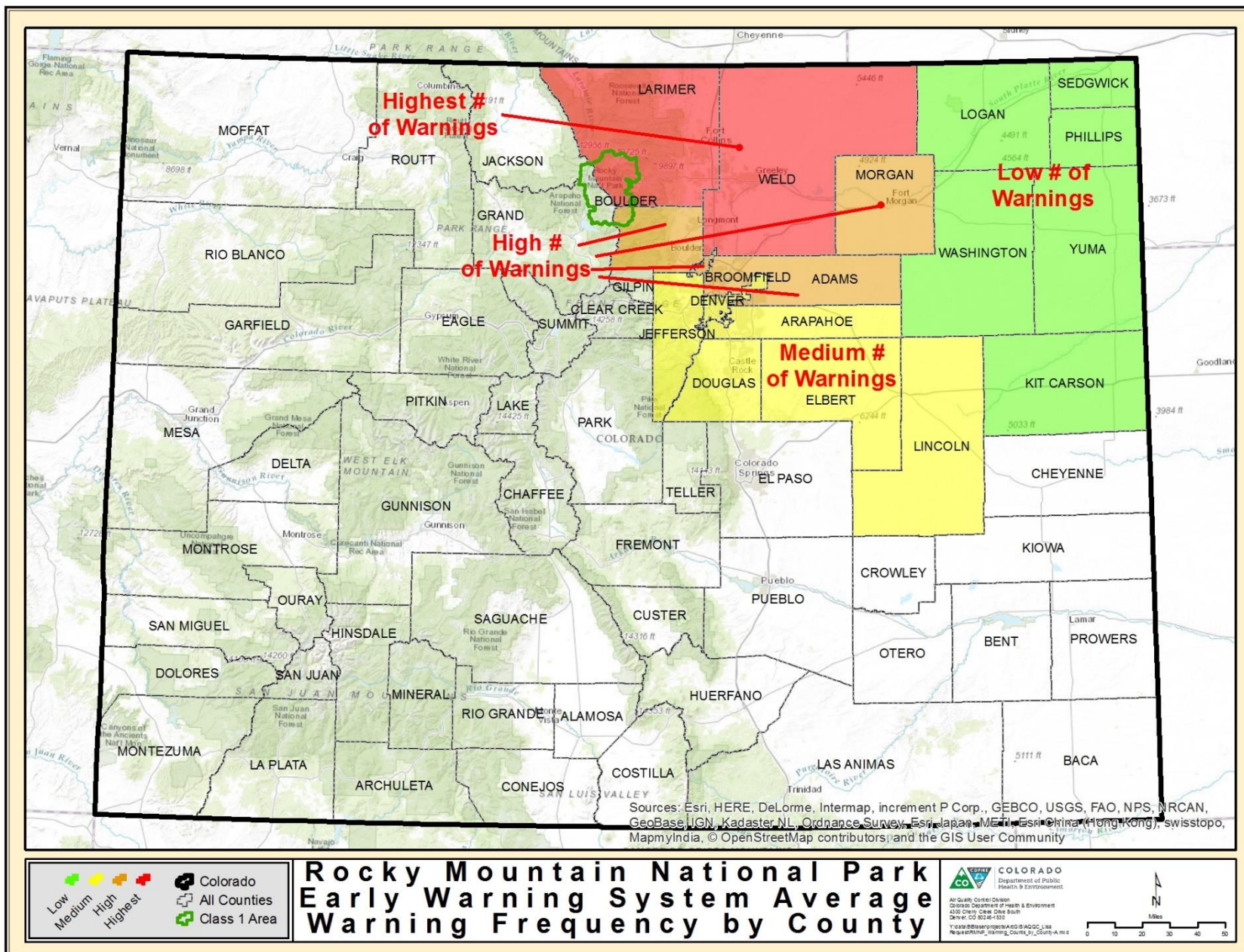


- Focus our efforts on what matters most geographically, by industry, or size of operation.
 - Improve understanding of the agricultural community's role to help inform reduction strategies and the next milestone decision.
 - Establish “S.M.A.R.T” indicator(s) of ammonia emissions (specific, measurable, achievable, relevant, time-bound). (e.g., beef production vs manure), and key data sources.
 - Use “S.M.A.R.T” indicator(s) to determine trends in agricultural ammonia emissions.
 - Evaluate efficacy of the Early Warning System followed by roll-out as warranted.



EARLY WARNING SYSTEM/ AGRICULTURAL POLLUTION PREVENTION PROJECT

- Goal: demonstrate effectiveness of pilot-scale “early warning system” that alerts agricultural producers in advance of upslope weather event likely to transport ammonia & reactive nitrogen into RMNP
 - Producers alter or delay farm or manure management practices until weather event elapsed
- Agricultural producer participants: 60
- Non-producer participants tracking warnings: 33
- Number of meteorological warnings April 2014 - Dec 2015
 - 2014: 10 warnings total (majority in July/Sept) (20 days total)
 - 2015: 15 warnings so far (majority in April/Oct) (31 total days)
- Affected producers provided 21 ± 5 responses per warning
 - 75% of respondents changed practices for full warning period
 - Additional 10% changed for portion of warning period
- Number of fact sheets developed/distributed: 3
- Early Warning System paper (Piña et al.) will be submitted by April 2017



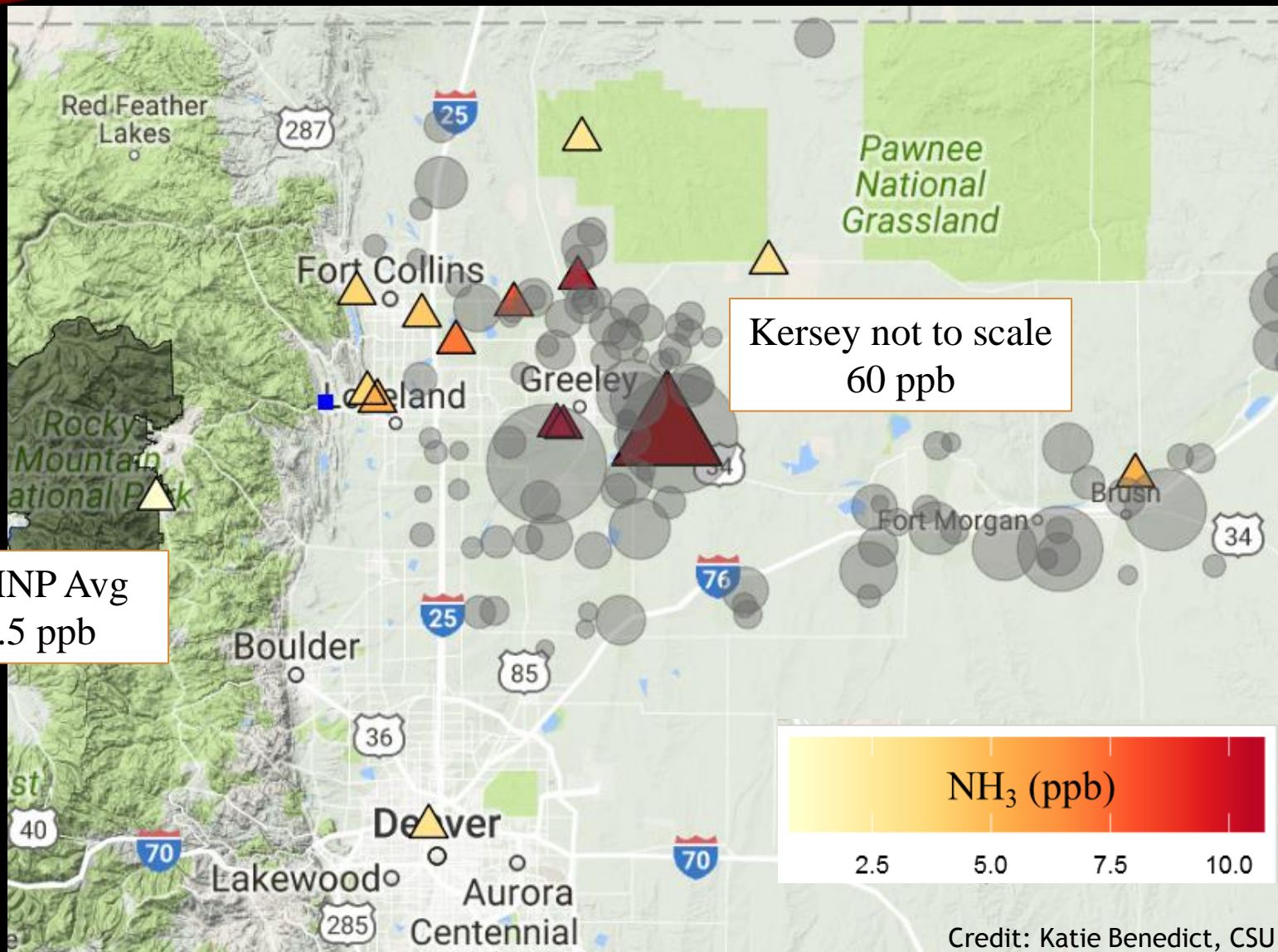
Credit: Colorado Livestock Association

MONITORING & RESEARCH PROJECTS



- Continuous ammonia monitors in Greeley (summer 2014; March-Oct 2015, 2016, planned for 2017) and Loveland (March-Oct 2015, 2016, beginning again March 2017) (NPS/CSU/NRCS/CDPHE)
- Additional monitor in RMNP (July 2014 March-Oct 2015, 2016, beginning again March 2017) (NPS/EPA)
 - Continuous ammonia
 - Daily ammonia, nitric acid, PM2.5 nitrate and ammonium
 - 3x/week wet dep of oxidized, reduced, and organic N
- USDA funded summertime ammonia network (March – October; 2017 will include several Denver area sites)
- Transect of High-Time Resolution Ammonia (NRCS/Weld County/CLA/Dairy Board/CDPHE)

2016 SUMMER AVERAGE MAP



MONITORING & RESEARCH PROJECTS



- Mobile ammonia measurements in NE Colorado (June 2016) (CDPHE)
- Upcoming 2017-2019 Denver/Boulder Urban Deposition Study (CDPHE/Denver/USGS/CU-Boulder/USFWS)
- Analysis of real-time data for evaluation of Early Warning System and source analysis (CSU)
- Comparison with Satellite Observations (CSU)
- Comparison with CAMx Model Simulations (CSU)

NO_x PROJECTS



- Case study for EPA's Policy Assessment for Review of Secondary NAAQS for NO_x
 - Notes that nitrogen deposition can alter species composition and cause eutrophication, drawing initial conclusions that existing standard does not protect such ecosystems and resulting services from impairment
- MOU agencies developing NO_x Emissions Reductions Fact Sheet for stakeholders
 - Issue and who's involved
 - Sources and regulations
 - Where do we want to be? (emissions)
 - What is being done about it for the future?

MOU AGENCY PLANS

- Planning for 2017 Milestone
 - Fill information gaps to inform the decision in 2018
- Focused effort with Agriculture Subcommittee to understand ammonia emissions, trends, and reduction efforts
- Supporting higher resolution ammonia monitoring in Front Range and Park
- Studies to further understanding of deposition factors and source apportionment
- Working to understand current and future oil and gas contributions
- Request next AQCC update shortly after 2017 Milestone Report release

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Questions?

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RMNP Website: www.colorado.gov/cdphe/rmnpinitiative

MILESTONE REPORTS: WEIGHT OF THE EVIDENCE APPROACH & CONCLUSIONS

- Assessment of multiple evidence types
- Two identified questions:
 - 20xx Nitrogen Deposition Interim Milestone met?
 - Will the RMNP Nitrogen Deposition Contingency Plan be triggered?
- Quantitative and Qualitative Factors
- *Therefore, the MOU agencies concluded that the 2012 interim milestone had not been achieved. However, the RMNP Nitrogen Deposition Contingency Plan was not triggered at this time.*



WEIGHT OF THE EVIDENCE SUMMARY (AS OF 2012)



- Demographic trends show Front Range population and vehicle miles increasing while agricultural counts steady
- NO_x emissions decreasing nationally and locally while ammonia emissions remain stable
- Efforts continue to improve Colorado's nitrogen emission inventories
- Significant NO_x reductions on the horizon expected to contribute to reduced nitrogen deposition in RMNP
- Ag Subcommittee and multiple ammonia-related research efforts promising
 - 5-year adaptive plan & Early Warning System pilot
- In-Park emission strategies in place
 - Vehicle transportation systems
 - Increases in fleet efficiency
 - Environmental Management System